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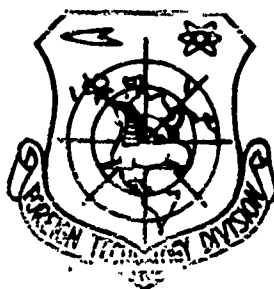


SOVIET ELECTRONIC DISPLAY SYSTEMS UNDER RESEARCH AND  
MANUFACTURED FOR THE CIVIL AVIATION AIRCRAFT OF THE 1990s

by

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**TITLE: SOVIET ELECTRONIC DISPLAY SYSTEMS UNDER RESEARCH  
AND MANUFACTURED FOR THE CIVIL AVIATION AIRCRAFT  
OF THE 1990s**

**FORWARD**

For many years, scientific research and production of on-board electronic equipment on Soviet civil aviation aircraft primarily directed its efforts to the resolution of the two problems below.

1. Guaranteeing a high degree of flight safety
2. Lowering operating expenses

Lightening the operating responsibilities of the aircrews is an effective method of raising the safety of flying. The operating responsibilities of aircrew personnel are primarily determined by the information capacity and ordeliness of the whole set of on-board equipment.

The question of lightening aircrew operating responsibilities, in the last ten years, has had special practical significance. The reason for this is that, in this time period, civil aviation aircraft have been equipped with various types of new model guidance and communications gear, automatic flight control equipment, and electric supply equipment. In conjunction with this, there has been a choice to make use of new piloting principles, such as those based on opting for the use of overall energy amount information.

Traditional information display equipment has only one function. Moreover, the majority of it is, in and of itself, associated with one state or condition. Because of this, in a situation where one is increasing display information sources as well as the number of their operating conditions, one also increased, in the aircraft cockpit, the amount of display equipment technology. This, in actuality, only lowered the work efficiency capabilities of men and machines in the cockpit.

The problem of lowering the expenses of utilization, in a situation where the costs of aviation technology are high, possesses important significance. The reason for this is that lowering the expenses of utilization is one of the most effective methods of

guaranteeing the economic profitability of civil aviation aircraft.

The technological maintenance expenses for an aircraft as a whole and its on-board equipment account for quite a large part of the utilization expenses. On the aircraft, opting for the use of kinds of technology and equipment which have forms of output such that information is stored for a long time, processed, and is easy to get access to (for example, in the case of on-board equipment, the location of malfunctions or deviations from some given operational mode or condition) is capable of lowering the expenses of technology maintenance. However, on the aircraft, the installation of auxiliary technology and equipment will lead to an increase in the weight of the equipment. The result of this is that it leads to a compensatory reduction in load, as well as an increase in the expenses of the aircraft as a whole.

#### MULTIPLE STATE MULTIPLE FUNCTION ELECTRONIC DISPLAY DEVICES

In the last 10-15 years, practical achievements in the world aircraft manufacturing industry clearly show that, in transport plane or passenger plane cockpits, the use of multi-function, multi-state electronic display devices in small numbers to replace large amounts of mechanical type and electro-mechanical type display devices is effective.

Multiple state electronic display devices for piloting parameters are capable of storing information content from flight crew personnel which is required as each independent flight stage is completed. Multiple state or condition electronic display devices for guidance parameters are capable of taking information selected by plane crew personnel concerning navigational modes and output and taking it for display on the screen in a corresponding form.

Opting for the use of two auxiliary multiple function electronic display devices is capable of guaranteeing using alphanumeric calculations and memory modes on the information supplied by aircrew personnel about the status of on-board systems as well as the status of aircraft accessories and operating conditions. On the basis of the check list prepared for the activities of a given flight stage, it is possible, in answer to the emergency signals of the aircrew members and warning signals as well as to aircrew personnel in repetitive situations, to supply the necessary operational orders.

Due to the fact that, inside cockpits, one sees installed multiple function electronic display devices, the result of this is that it is not necessary to have a large number of optical signal display panels and a large group of engine parameter display devices.

The second problem when deciding to lower the expenses of utilizing aviation equipment is also capable of being solved by opting for the use, in aircraft, of multiple function electronic display devices. In order to do this, the use of specialized memory equipment (storing, in the aircraft, information on the locations where malfunctions occur in flight) as well as the addition of control platforms or panels is adequate to supplement the on-board signal systems, including multiple function electronic display systems.

This type of system is capable of making ground maintenance personnel obtain relevant information on the status of on-board equipment and information on the location of malfunctions which occur in flight. In this way, it is then not necessary to have specialized technological test equipment. It is possible to shorten the time for technology maintenance as well as reducing the probability of error.

ELECTRONIC DISPLAY SYSTEMS FOR CIVIL AVIATION AIRCRAFT OF THE 1990s

At the present time, the Soviet Union is just in the midst of and will do more research on and manufacturing of electronic display systems for the civil aviation aircraft of the 1990s. There is the **СЭИ** Model (used in **ИЛ-96** aircraft), the **КМСС** Model (used in **ТУ-204** aircraft) and the **КСЭИ** Model (used in aircraft on local routes) for a total of three types.

I. **СЭИ** Model Electronic Display Systems. The **СЭИ** Model electronic display system was manufactured for the large model passenger plane of the 1990s, the **ИЛ-96**. When test manufactured, consideration was given to the experience of various countries of the world in the manufacture and utilization of similar systems as well as to the requirements mandated by ARINC 725. The **СЭИ** Model electronic display system is used in mountings on a complete set of digital navigational-piloting equipment for civil aviation aircraft. In

in conjunction with this, on the basis of ARINC 429, it receives information in the form of string line 32 position code.

The CSM Model electronic display system includes two pilot parameter display devices, two navigational or guidance parameter display devices (one of each type of model for the left and right pilots), three computer sets (graphics generators) and two control panels. Pilot parameter electronic display devices and navigational parameter electronic display devices are all standard.

The display device's principal parts are a covered or shaded type of color cathode ray tube having a screen with dimensions of 110x170mm. The cathode ray tube and polarization system together form a unified modular structure. In order to produce graphics, the display device processors are mounted inside the display devices. The high voltage power source that is required by the cathode ray tube is also mounted inside the display device. This sort of unitization is capable of eliminating the analog linkages between the display device and the computer sets. Due to the fact that there is no high voltage transmission line, the result is that the stability of the connection between the display device and the computer sets are increased. The three computer sets are all interchangeable or universal. They are built on the basis of modern microprocessor technology. Moreover, they possess a modular form, a general line or bus structure for information exchange, and micro program control. The first set guarantees the function of the left pilot's display device. The second set guarantees the function of the right pilot's display device. The third set is a back up.

The control panel is used in internal changes of direction of the various parts in the system. It is used in changing the operational connection of the display devices, when the system has internal malfunctions or during testing, to adjust the brightness of imagery, as well as to take certain flight parameters and input them into the system. In the system, the testing of mounted equipment and the testing of programming is stipulated.

On the CSM Model electronic display system's pilot parameter display device screen, it takes alpha-numeric and symbolic forms and

displays information on the aircraft's current and given angular locations. It displays information on the current and given altitudes and speed parameter values (there are displays of limit and permissible values) as well as other information needed for safe piloting.

1 零件名称	质量 6 (kg)	所需功率 7 (W)	尺寸 8 (mm)	平均无故障 间隔时间(h) 9
2 驾驶参数电子显示器	14.5	180	192×230×356	3000
3 导航参数电子显示器	14.5	180	192×230×356	3000
4 计算机组 (图像发生器)	8	35	387.5×198.5× 194.5	5000
5 操纵台	3.8	10	146×176×230	30000

Key Structural Characteristics of the Various Parts of the CM Model Electronic Display System (1) Part Nomenclature (2) Piloting Parameter Electronic Display Device (3) Navigational Parameter Electronic Display Device (4) Computer Set (Graphics Generator) (5) Control Panel (6) Mass (7) Power Required (8) Dimensions (9) Average Hour Interval Without Malfunction

The navigational parameter electronic display device operates in the three types of graphics modes set out below.

1. Navigational-piloting instrument mode
2. Map mode
3. Weather graphics mode

The weather data graphics are capable of being superimposed on the map mode.

11. The KMCC Model electronic display system (Comprehensive Type Signal Information Transmission System). The KMCC Model electronic display system is a comprehensive type of signal information transmission system. The foundation of the KMCC Model system is the human-machine engineering relating to the advanced signal transmission system built into the cockpit as well as the systems engineering, and the results of research on the area of circuit technology. This type of system will be the main display equipment for information on board the large passenger plane of the 1990s, the TY-204. During test production of the KMCC Model electronic display system, consideration was given to the experience of the design personnel on the EICAS system and the ECAM system, as well as the requirements stipulated by ARINC 726, ARINC 429, and ARINC 729.



The KMCC Model comprehensive type signal information transmission system is composed of two multiple function electronic display devices, two computer sets, two graphics generators, two display device control panels, and four information transformation devices. The system's two electronic display devices are both equally capable of guaranteeing the taking of alpha-numeric, symbolic, and graph and table forms and the reproduction of color graphics.

The KMCC Model comprehensive type signal information transmission system is used in order to put out information to aircrew members on on-board systems and the operating status of aircraft accessories, as well as information on deviations from normal operating conditions. It puts out emergency responses to situations and warning reports forecasting emergency situations to be responded to. It displays immediate values for parameters of engines, and a certain number of other systems and accessories, as well as putting out, in certain situations, control orders to members of the aircrew.

Inside the KMCC Model comprehensive type signal information transmission system, it is stipulated to take the characteristic sound notification signals and reproduce them on the electronic display device. In conjunction with this, there is mutual action with the language broadcast equipment. The information is entered into the system's logic processing equipment. On the basis of the stipulated priorities, it guarantees that the appropriate notifications are put out. Based on changes in the importance of information from the various different flight stages, it stipulates changes in the signal priorities, as well as, in particularly important flight stages (for example, during take offs and landings) carries out chaining to notifications of next importance. In the system, one opts for the use of color type codes. It is possible to make information reappear on the display screen.

The high quality and high reliability of the C3H Model and KMCC Model electronic display systems is guaranteed by the series of measures below.

1. In display devices a choice is made for the use of cathode ray tubes of high brilliance. They have three electron guns and the

capability to resist the effects of external machinery as well as the effects of weather.

2. The systems opted for the use of radio electronic parts which were already in mass production in industry and firmly grasped.

3. They guaranteed the lightening of the electrical load of the radio electronic parts.

4. They adhered to rational structures to guarantee moderate heating in operating conditions of electrical modules.

5. On the basis of the program, it was guaranteed that the design, test manufacturing, and their adjustment and testing were made automatic.

6. At the specialized science and technology center, thorough going test platform studies and flight research were carried out.

III. The КСЭМС Model electronic display system. The КСЭМС Model electronic display system is the electronic display system of the 90s for aircraft on local routes in the Soviet Union and needs to be studied and produced as a next step. The test production of the system in question will absorb the accumulated experience from design processes for the СЭМ Model and КМСС Model electronic display systems.

The key tasks in the manufacture of the КСЭМС Model electronic display system are:

1. Reducing overall perimeter dimensions-mass characteristics;
2. Reduce the required power;
3. Facilitate technology maintenance;
4. Lower production costs.

When manufacturing the КСЭМС Model electronic display system, consideration was given to the trend in electronic equipment in the direction of the development of unitization or integration. Because of this, the system in question not only will guarantee the use of graphics display navigation-piloting information (СЭМ Model system functions). Moreover, it will also guarantee the use of on-board graphic display equipment as well as information on the situation reference the operating status of aircraft accessories (a КМСС Model system function).

The KC3MC Model electronic display system is composed of 5 standard color electronic display device units. Its operations are assured by 3 computer units. The computer units of the system in question will also guarantee the piloting signal transmission mandated by ARINC 726, that is, to the members of the aircrew, the putting out of warnings of approaches to limits-allowable values of flight parameters.

1 部 件 名 称	7 质 量 (kg)	8 所需功率 (W)	9 尺 寸 (mm)	10 平均无故障 间隔时间(h)
2 电子显示器	14.5	150	192×230×350	5000
3 图像发生器	6	25	387.5×198.5×128.5	5600
4 计算机组	9	35	387.5×198.5×194.5	5700
5 信息采集 和变换器	8	35	387.5×198.5×194.5	6100
6 操纵台	2.5	40	146×112×231	30000

Key Structural Characteristics for the Various Parts of the Model Comprehensive Type Signal Information Transmission System (1) Part Nomenclature (2) Electronic Display Device (3) Graphics Generator (4) Computer Unit (5) Information Collection and Transformation Device (6) Control Panel (7) Mass (8) Required Power (9) Dimensions (10) Average Number of Hours Without Malfunction

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